Technical Report: Part Two



Rendering courtesy of Devrouax & Purnell Architects

Jonathan Cann Option: Mechanical Consultant: Prof. Treado Date: 10/6/2014

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Executive Summary

Technical Report Two evaluated the Elementary School One's mechanical system as designed. The design load, energy consumption and cost of operation were modeled in Trane Trace 700 using information gathered from drawings and specifications.

Load calculation was performed using input of building materials, weather, internal loads and equipment. The calculations were done by block loads. The blocks were determined by the units and systems serving the areas.

The building equipment was analyzed for their energy consumption along with the buildings total consumption. The energy usage was broken down for each type of equipment. The building emissions was also calculated to see the impact on the environment. Finally, a cost analysis was performed to see the building operational costs annually and monthly. Elementary School One consumes 4,845,829 kBtu/yr, which is an annual cost of \$47,581 for gas and electric. The building operational cost is on the cheaper side being only 0.85 \$/sq ft.

Building Overview

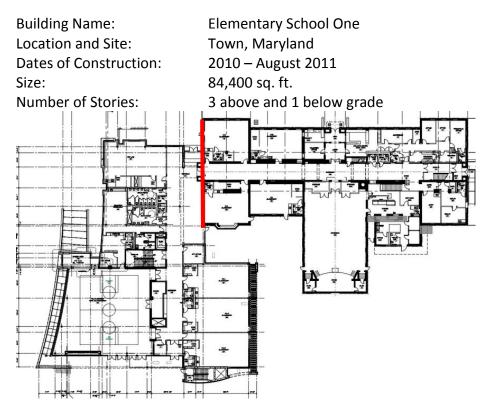


Figure 1: First Floor Plan.

The red line separates the existing building and the addition. The existing is on the right and the addition is on the left.

Mechanical Systems Summary

Elementary School One modernization involved a renovation of the existing building and adding an addition on the west side. All new mechanical systems were applied to both the existing and the addition. The mechanical system has three dedicated outside air RTUs that supply VAV boxes in each space. Each space then exhausts air back to the RTUs for heat wheel. There are three VRF systems that condition these spaces with dedicated outside area.

Two RTUs serve the cafeteria and two serve the multipurpose room. There are also base board radiators and cabinet heaters in some of the spaces near the exterior. In the administrative section of the existing building, an AHU conditions the spaces with its own outside air intake.

Design Load Estimation

To analyze the load on Elementary School One, Trane Trace 700 was used. This program analyzed the building based on location, envelope materials, occupancy, internal loads and equipment. The calculation accounts an entire year of data to find the peak heating and cooling loads. Below are the areas chosen for the block analysis.

Blue-	RTU-1 and 2 serve cafeteria
Orange-	RTU-3 and 4 DOAS serve the existing building (heat wheel)
Purple-	RTU-5 DOAS serve the addition (heat wheel)
Green-	RTU-6 and 7 serve the multipurpose room
Red-	AHU serves administrative offices



Figure 1: First Floor Block Layout

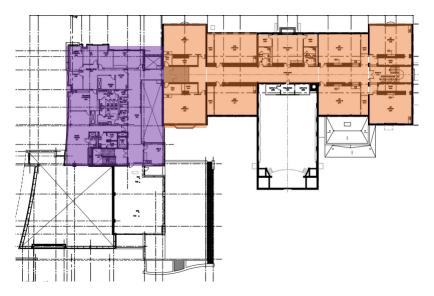


Figure 2: Second Floor Block Layout



Figure 3: Third Floor Black Layout

Design Assumptions

The program allows input of internal loads such as lighting, occupancy and equipment loads. The actual design input were used when possible and some were assumed larger in the model to be precautionary. Lighting density was assumed at 2 W/ sf, which is larger for some spaces. Occupancy actual design was used for RTU-1, 2, 6 and 7. The other blocks occupancy was assumed classroom or office space density depending on primary use. Miscellaneous equipment loads were assumed for areas with high density computer and other office equipment. The schedule of building operation was based on average school hours.

	Summer	Winter
Designed Dry Bulb (°F)	91	13
Designed Wet Bulb (°F)	77	-
Indoor Air Temperature (°F)	75	72

Figure 4: Weather based on Baltimore, Maryland data.

Design Load Estimation Results

The estimated modeled loads are compared with the design loads in the figures below. The estimated loads are larger than the designed loads for a couple reasons. The location of the building has been moved to a colder climate and higher estimation of the internal loads. RTU 1, 2, 6 and 7 modeled are close to the designed capacities. These units serve the cafeteria and the multipurpose room and supply over 4 cfm/ sq ft because of the double height ceilings. There was no information on the design loads of AHU that serves the administrative offices, but 1.37 cfm/ sq ft seems to be high for that type of space. The administrative space should be closer to 1.0 cfm/ sq ft.

The RTU-3, 4 and 5 loads are largely off by a factor of 50%. This is due to the program limitations. Trane Trace 700 does not allow multiple systems to operate one space and those spaces have dedicated outdoor air (VAV) with VRF system to further condition the space. The system inputted into the program was a VRF with dedicated outdoor air in the same package unit. This adapted input is skewing my results for those spaces. Also, the controls of the designed system is very elaborate compared to the controls that could be inputted into Trane Trace in the simplified block estimation.

Modeled:

	Cooling Capacity (MBh)	Heating Capacity (MBh)	cfm/sq ft
AHU	57.8	112.1	1.37
RTU-1,2	344.8	118.3	4.47
RTU-3,4	1557.1	1542.11	1.54
RTU-5	1439.6	1181	1.54
RTU-6,7	527.1	145.3	4.07

Figure 5: Modeled load calculation results.

Designed:

	Cooling Capacity (MBh)	Heating Capacity (MBh)	cfm/sq ft
AHU	n/a	n/a	n/a
RTU-1,2	309.8	125.7	4.81
RTU-3,4	914.1	932.4	1.1
RTU-5	867.7	742.3	1.1
RTU-6,7	359.8	217.7	3.42

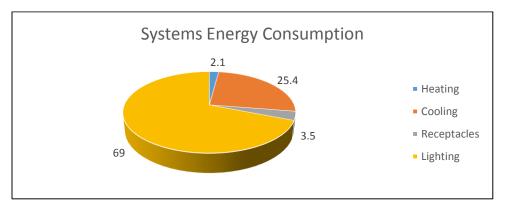
Figure 6: Designed load calculation from sponsor.

System Energy Consumption & Costs

System Comparison

Elementary School One consumes 4,845,829 kBtu/yr, which can be seen in Figure 7. Most of the energy consumed by the building is due to the lights. School only operates during normal school hours plus extracurricular activities after hours. The energy consumed cannot be decreased much because of the lighting requirements of ASHRAE. The second largest energy usage is mechanical cooling. This includes each RTU and AHU to cool the spaces. The school is not in full operation during the summer so the set temperature is higher so less cooling is needed. The operation spaces during the summer are mostly administrative offices which have their own AHU to condition that space.

Equipment Energy Consumption



	% of Total Building Energy	Total Building Energy (kBtu/yr)
Heating	2.1	99,919
Cooling	25.4	1,232,861
Receptacles	3.5	168,870
Lighting	69	3,344,179
Total	100	4,845,829

Figure 7: Equipment energy consumption modeled in Trane.

Monthly Energy Consumption

The monthly energy usage is mostly electricity because of the lights and equipment, seen in Figure 8. There is a small increase in electricity usage during the summer due to the increase in cooling. Gas is only used during the colder months for heating, but the energy usage of gas is very small compared to the electricity.

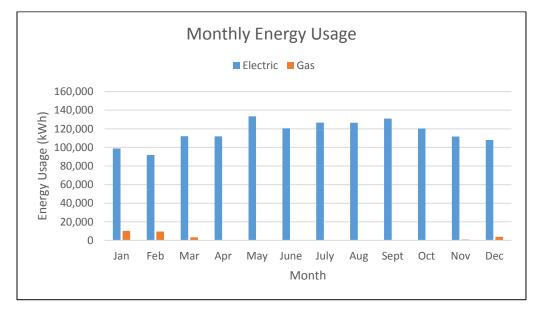


Figure 8: Monthly energy usage of electricity and gas.

Building Energy Cost Analysis

The energy cost was found from the areas electricity and gas providers. The cost of electricity currently in the area is 13.1 cents per kWh. The cost of gas is \$1.044 per therm currently and one therm is equal to 29.3 kWh.

The yearly estimated cost of electricity is \$46,979 and the estimated cost of gas is \$602. This brings the total operation cost of the equipment to \$47,581. The building conditioned spaces are 55,927 sq ft and the utility cost per area is 0.85 \$/sq ft.

Environmental Impact

The environmental impact of the building systems can be seen below in Figure 9. Electricity is inefficacy source of energy and it contributes most of the impact to the environment.

Environmental Impact						
Analysis						
CO2 1,862,997 lbm/yr						
SO2 16,776 gm/yi						
NOX	3,210 gm/yr					

Figure 9: Gaseous emissions analysis from Trane model.

Mechanical Energy Break Down

The largest amount of energy used in the mechanical system is the air-cooled chiller which is a part of the VRF system that conditions most of the building. Next, largest is the packaged RTU that serve the cafeteria and the multipurpose room. The majority of the energy consumed by the mechanical system is to cool the spaces.

Annual Energy Usage per Equipment

	Energy (kWh)
Air-cooled chiller	312,662
Packaged RTU	47,742
Boiler	923
Boiler Fan	1,906
Control Panels	1,114

Figure 10: Distribution of energy usage among equipment.

References

ASHRAE (2013) Standard 62.1- Ventilation for Acceptable Indoor Air Quality

ASHRAE (2013) Standard 90.1- Energy Standard For building Except Low-Rise Residential Buildings

"Department of Public Works." Department of Public Works. N.p., n.d. Web. 06 Oct. 2014.

"U.S. Bureau of Labor Statistics." *U.S. Bureau of Labor Statistics*. U.S. Bureau of Labor Statistics, n.d. Web. 05 Oct. 2014.

Appendix A- Room Templates

Administrative

Alternative 1					Apply
Room description Admin		•			<u>C</u> lose
Templates	Length	Width			
Room Default 💌	Floor 116	ft 27.7 ft			<u>N</u> ew Room
Internal Default	Roof 🕞 🛛	ft 0 ft			Сору
Airflow Default	C Equals flo	DOF			Delete
Tstat Default 💌					
Constr Default 💌	Wall				
	Description Length (ft)				Window
	north 116	12.5 0		0	
	west 6	12.5 270	0 0 0	0	
	east 32	12.5 90	0 0 0	0	
	Internal loads		Airflows		
	People 143	sq ft/person 💌	Cooling vent	0 cfm	•
	Lighting 2	W/sq.ft 🔍	Heating vent	0 cfm	•
	Misc loads 1	W/sq.ft 💌	Cooling VAV min	30 % Clg Airfle	w 💌
			Heating VAV max	100 🛛 🔏 Clg Airfle	▼ wc
Single Sheet Booms	Roofs	<u>W</u> alls	Int Loads	Airflows	Partn/Floors

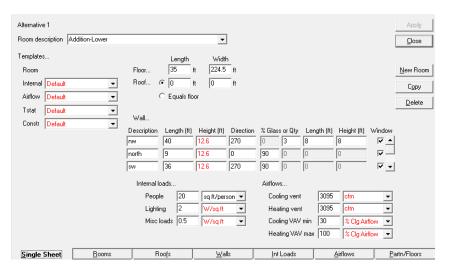
Cafeteria

Alternative 1					Apply
Room description Cafeteria		-			Close
Templates Room Default Internal Default Airflow Default Tstat Default		Width ft 46 ft ft 0 ft por			<u>N</u> ew Room C <u>o</u> py Delete
Constr Default 💌	Description Length (ft) west 54 south 46 east 54	Height (ft) Direction 15.5 270 15.5 180 15.5 90	% Glass or Qty Lenge 0 0 0 0 0 0 0 0 0 0 0 0	gth (ft) Height (ft) V	
	Internal loads People 249	Develo	Airflows	5000 cfm	
	Lighting 2 Misc loads 0.5	People • W/sq ft • W/sq ft •	Cooling vent Heating vent Cooling VAV min Heating VAV max	5000 cfm 30 % Clg Airflo	
Single Sheet Rooms	Roo <u>f</u> s	<u>W</u> alls	Int Loads	Airflows	Partn/Floors

Multipurpose

Alternative 1						Apply
Room description	Multi-purpose		•			Close
Templates Room Default Internal Default Airflow Default Tstat Default Constr Default		Length Floor 60 Roof C 0 @ Equals Vall Description Length (I 20	ft 67 ft ft 0 ft floor	% Glass or Qty Ler	igth (ft) Height (ft) \	New Room Cgpy Delete
		west 62 south 72	24 270 24 180	90 0 0 20 0 0		
		Internal loads		Airflows		
		People 265 Lighting 2 Misc loads 0.5	W/sq.ft 🔹	Cooling vent Heating vent Cooling VAV min Heating VAV max	5000 cfm 5000 cfm 30 % Clg Airfld 100 % Clg Airfld	
Single Sheet	Booms	Roofs	Walls	Int Loads	<u>A</u> irflows	

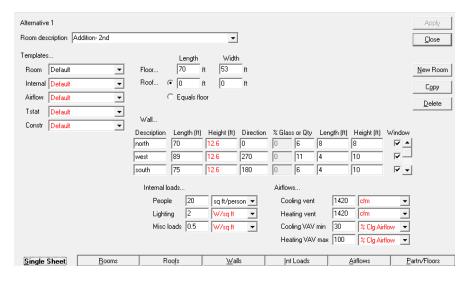
Addition- Lower Level



Addition- First Level

Alternative 1										Apply
Room description Addition-1st			-	1						<u>C</u> lose
Templates Room Default Internal Default Airflow Default	Floor Floor Roof		Widt ft 116 ft 0	h ft ft						New Room
Tstat Default Constr Default	Wall Description north west south	n Length (ft) 103 78 67	Height (ft) 12.6 12.6 12.6	Direction 0 270 180	_	or Qty 6 11 2	Length (ft) 8 4 9	Height (ft) 8 8 12	Window	Delete
	Pe Lig	nl loads ople 20 hting 2 c loads 0.5	sq ft/per W/sq ft W/sq ft	son V V	Heat Cooli	s ing vent ing vent ing VAV ing VAV	2960 min 30		▼ ▼ flow ▼	
Single Sheet Boor	ns	Roo <u>f</u> s	<u>₩</u> a	lls	<u>I</u> nt I	Loads		Airflows	<u> </u>	artn/Floors

Addition- Second Level



Addition- Third Level

Alternative 1 Room descriptio	n Addition- 3rd			-					[Apply <u>C</u> lose
Templates Room Defa Internal Defa Airflow Defa	ult			Width ft 47 ft 0	n ft ft				-	<u>N</u> ew Room C <u>o</u> py Delete
Tstat Defa Constr Defa		Wall Description north west south	Length (ft) 70 90 65	Height (ft) 12.6 12.6 12.6	Direction 0 270 180	% Glass or Qty 0 6 0 8 0 2	Length (ft) 8 3.3 6.5	Height (ft) 8 9 10	Window V	
		Internal Ic Peopl Lightir Misc I	e 20 ng 2	sq ft/per W/sq ft W/sq ft	son 💌	Airflows Cooling ven Heating ver Cooling VAV Heating VAV	nt 1400 /min 30		▼ ▼ flow ▼	
Single Shee	t <u>B</u> ooms	B	po <u>f</u> s	<u>₩</u> a	ls	Int Loads		Airflows	Pa	tn/Floors

Existing- First Level

Alternative	1											Apply
Room desc	cription E	xisting-1st			•]						<u>C</u> lose
Templates.	 Default		F la a	Length	Widt ft 121	h ft						New Room
		_	Floor Roof		ft 0	n ft						
Internal		_		- J•	,	rt						Сору
;	Default	-		C Equals flo	loc							<u>D</u> elete
Tstat	Default	<u> </u>	Wall									
Constr	Default	-	Description	Length (ft)	Height (ft)	Direction	% Glass or Q	tv Le	ngth (ft)	Height (ft)	Window	
			north	70	12.6	0	0 7	5.5		7	▼ ▲	
			west	22	12.6	270	0 0	0		0	Γ-	
			south	136	12.6	180	0 12	5.5		7	V .	
			Internal l	oads			Airflows					
			Peop	le 20	sq ft/per	son 💌	Cooling v	ent	2740	cfm	•	
			Lighti	ng 2	W/sq.ft	-	Heating v	ent	2740	cfm	•	
			Misc	loads 0.5	W/sq.ft	-	Cooling V	AV min	30	% Clg Airl	ilow 💌	
							Heating V	AV max	100	% Clg Airl	low 💌	
Single 9	Sheet	<u>R</u> ooms	R	oo <u>f</u> s	<u>W</u> a	lls	Int Load	s		Airflows	E	artn/Floors

Existing- Second Level

Alternative 1 Room description Existing- 2nd		•			Apply Close
Templates Room Default Internal Default Airflow Default Tstat Default	Length Floor 192 Roof c 0 C Equals fl	Width ft 43 ft ft 0 ft			<u>N</u> ew Room Cgpy Delete
Constr Default	Wall Description Length (ft) north 192 west 22 south 140	Height (ft) Direction 12.6 0 12.6 270 12.6 180	% Glass or Qty Ler 0 19 4.5 0 2 4.5 0 15 4.5	9	Window
	Internal loads People 20 Lighting 2 Misc loads 0.5	sq ft/person ▼ W/sq ft ▼ W/sq ft ▼	Airflows Cooling vent Heating vent Cooling VAV min Heating VAV max	6440 cfm 6440 cfm 30 % Clg Airl 100 % Clg Airl	
Single Sheet Booms	Roo <u>f</u> s	<u> </u>	Int Loads	Airflows	Partn/Floors

Existing- Third Level

Alternative 1									Apply
Room description	n Existing- 3rd			-]				Close
Templates			Length	Widt	h				
Room Defa	ult 💌	Floor	192	ft 45	ft				<u>N</u> ew Room
Internal Defa	ult 💌	Roof	0	ft 0	ft				Сору
Airflow Defa	ult 💌		Equals flo	nor					Delete
Tstat Defa	ult 💌								
Constr Defa	ult 👻	Wall							
		Description	Length (ft)		Direction		Length (f		Window
		north	192	12.6	0	0 19	4.5	9	✓ ▲
		west	46	12.6	270	0 2	4.5	9	
		south	192	12.6	180	0 17	4.5	9	▼
		Internal l	pads			Airflows			
		Peop	le 20	sq ft/per	son 🔻	Cooling vent	560	0 <mark>cfm</mark>	-
		Lighti	ng 2	W/sq ft	-	Heating ven	, 1560	0 <mark>cfm</mark>	
		-	loads 0.5	W/sq ft		- Cooling VAV		% Clg Airf	low 🔻
			,		_	- Heating VAV			
							,		
Single Shee	t <u>R</u> ooms	R	oo <u>f</u> s	<u>W</u> a	lls	<u>I</u> nt Loads		Airflows	Partn/Floors

Appendix B- Zone Check Sums

Elementary School One

	Location Building owner Program user Company Comments	Maryland
	By Dataset name	ACADEMIC X:_THESIS\TECH 2.trc
ACA	Calculation time TRACE® 700 version Location Latitude Longitude Time Zone Elevation Barometric pressure	05:59 PM on 10/06/2014 6.3 Baltimore, Maryland 39.0 deg 76.0 deg 5 146 ft 29.8 in. Hg
USE	Air density Air specific heat Density-specific heat product Latent heat factor Enthalpy factor Summer design dry bulb Summer design dry bulb Winter design dry bulb Summer clearness number Winter clearness number Summer ground reflectance Winter ground reflectance Carbon Dioxide Level	0.0756 lb/cu ft 0.2444 Btu/lb·°F 1.1091 Btu/h·cfm.°F 4.881.9 Btu·min/h·cu ft 4.5371 lb·min/h·cu ft 91 °F 77 °F 13 °F 0.85 0.85 0.20 0.20 400 ppm
	Design simulation period Cooling load methodology Heating load methodology	January - December TETD-TA1 UATD
TRANE		TRACE 700

Ву	Zone
ACADEMIC	Checksum
	S

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Total	Opt Vent	Main Cig Aux Cig			Grand Iotal ==>	Total Total	Underflr Sup Ht Pkup Supply Air Leakage	Duct Heat Pkup	Sup. Fan Heat Ret. Fan Heat	Exhaust Heat	Ov/Undr Sizing	Dehumid. Ov Sizing	Adj Air Trans Heat	Ceiling Load Ventilation Load		Sub Total ==>	Misc	Lights	Internal Loads		Sub Total ==>	Adjacent Floor	Floor	Partition/Door	Glass/Door Cond Wall Cond	Root Cond Glass Solar	Skylite Cond	Skylite Solar	Envelope Loads				
56.7	19.3	0.0	-	Total (,	eakage	Kup			ing	v Sizing	s Heat	oad		ÿ			ds		Û	loor		Ø	r Cond	-	đ	ar.	bads	Sen		Peaked at Time: Outside Air:	co
680.3	231.2	0.0		Total Capacity on MBh	008/675	305 050					•		0 0	2,893		231,365	4,323	44,342			91.692		• •		3,905	0 78,567	, 0	0	Btu/h	Sens. + Lat.		a Airc	OLING CO
	118.2	0.0	200	COOLING COIL SELECTION Sens Cap. Coil Airflow Enter MBh cfm *F	5,380	E 300	0	0	•	-3,691				-2,893		11,085	0	11,085			879	0	,		870	• •		0	Bturh	Sens. + Lat	2	Mo/F OADB/WB/H	COOLING COIL PEAK
	2,960	0	10001	Coil Airflow	449,000	110 000	0 0	0		-3,691	0		0	117 735		242,450	4,323	182,700			92.571			•	9,905	78,567	, 0		Btu/h	Total		Mo/Hr: 7/18 OADB/WB/HR: 87/74/106	
	91.0 76.9	0.0 0.0		Enter DB/WB/HR	100.00	8	• •		• •	<u>د م</u>		•	•	200		54	-	4 12			24.0			•	4 12	10			(%)	Of Total		6 	0
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	55.0 54.9	0.0 0.0		Leave DB/WB/HR			<u>ې د</u>	S	2 2	0	0	1.14		< 0		61		4 #			37		•	•		32 0			(%) Er	Of Total		7/18 87	PEAK
	64.7 II	0.0	r	gr/lb	Grand Total	Tata	Underflr Sup Ht Pkup Supply Air Leakage	System Plenum Heat	KA Preheat Diff. Additional Reheat	OA Preheat Diff.	Exhaust Heat	Ov/Undr Sizing	Adj Air Trans Heat	Ceiling Load		Sub Total ==>	Misc	Lights	Internal Loads		Sub Total ==>	Adjacent Floor	Floor	Partition/Door	Glass/Door Cond	Glass Solar	Skylite Cond	Skylite Solar	Envelope Loads				
ExFir Roof Wall Ext Door	Int Door	Part		Gross Total			Pkup age	Heat	at.				2												and					s s	,		H
4,385 1,233 0 0	0	0,120		AS	C/8,001-	400 070						-114,940	•	-2,548		•	•	0 0			-49,387		•	•	-43,387	•••		•	Bturh	Space Peak Space Sens		Mo/Hr: Hea OADB: 13	HEATING COIL PEAK
0 ³³ 0 28 0				Glass ft² (%)	-301,700	964 764		-11,894			3,251	-114,940	0	-187.119		_					-51,057				-43,387				Bturh	Tot Sens		Mo/Hr: Heating Design OADB: 13	JIL PEAK
Humidif Opt Vent Total	Preheat	Main Htg Aux Htg		H		\$	0.00	_	0.00	0.00		31		51.72		0.00	0.00	0.00					0.00			0.00		0.00		of Total			
0.0 -361.8	0.0	0.0	201 0	HEATING COIL SELECTION Capacity Coil Airflow I MBh cfm	No. People	Btu/hr-ft*	cfm/ton ft²/ton	cfm/ft ²	% OA		ENGIN		Leanage ope	Leakage Dwn	Auxiliary	Rm Exh	Exhaust	MinStop/Rh Return	Infil	AHU Vent	Nom Vent		Terminal Main Fan	Diffuser		A		Fn Frict	Fn MtrTD Fn BidTD	Ret/OA	Ra Plenum	SADB	TEMP
	0	0		NG COIL SELECTION Capacity Coil Airflow MBh cfm	ŝ	83.78	176.94 143.23	1.24	29.5	Cooling	ENGINEERING CKS				0	0	2,960	3,009		2,960	2.960	10,001	10,031	10,031	Cooling	AIRFLOWS		0.0	0.0	79.4	76.1	Cooling 53.0	TEMPERATURES
0.0	0.0 0.0	0.0 0.0		Ent Lvg		-44.55		1.24	29.5	Heating	ŝ					•	2,960	10,031		2,960	2,960		10,031	10,031	Heating			0.0	0.0	52.5	69.0	Heating 85.0	0

Project Name: Elementary School One Dataset Name: TECH 2.trc

TRACE® 700 v6.3 calculated at 05:59 PM on 10/06/2014 Alternative - 1 System Checksums Report Page 1 of 10

Ву	Zone
ACADEMIC	Checksums

Addition- 2nd

Ov/Undr Sizing Exhaust Heat Main Clg Aux Clg Opt Vent Supply Air Leakage Ceiling Load Ventilation Load Skyllte Solar Skyllte Cond Roof Cond Glass Solar Glass/Door Cond Wall Cond Grand Total ==> Duct Heat Pkup Ret. Fan Heat Sup. Fan Heat Dehumid. Ov Sizing Adj Air Trans Heat Envelope Loads Underflr Sup Ht Pkup Internal Loads Misc Lights People Floor Sub Total ==> Sub Total ==> Adjacent Floor Partition/Door Infiltration Peaked at Time: 23.1 Total Capacity ton MBh 9.2 Outside Air: COOLING COIL PEAK Sens. 213,239 20,260 106,663 93,775 9,753 3,136 105,254 Space 5. + Lat. 277.3 1,322 1,519 110.9 Btuh 0 0 0 Sens Cap. MBh Sens. + Lat COOLING COIL SELECTION Mo/Hr: 7 / 18 OADB/WB/HR: 87 / 74 / 106 Plenum -1,322 0 171 198.4 5,065 0 1,051 3,024 5,065 1.051 Btulh 56.7 00 0 0 0 0 00 000 Coil Airflow cfm 277,332 0 61,070 107,714 110,319 25,324 83,475 0 93,775 9,753 9,753 7,955 -1,771 1,519 1,420 Btuh Total Net 00 000 0 0 0 0 Percent Of Total 91.0 78.1 8 100.00 F oF 2 0 20 â 8 9 8 ¥ 400 0 000 -64.8 0.0 0 0 76.9 CLG SPACE PEAK VBIHR 118.3 **Bulb** Sensible 0.0 176,446 105,304 69,863 20,260 2,929 94,197 3,229 8,178 Space OADB: 86 Mo/Hr: 8 / 17 Btwh ,279 000 0 0 0 0 0 0 Percent Of Total 55.0 53.2 0.0 0.0 100.00 55.0 54.9 "F "F 3 26 🕇 8 . 2000 ð 0 Exhaust Heat 00 0 0 10 CR Ventilation Load Skylite Solar Skylite Cond Roof Cond Glass Solar OA Preheat Diff. RA Preheat Diff. Grand Total ==> Adj Air Trans Heat Additional Reheat System Plenum Heat Supply Air Leakage Underflr Sup Ht Pkup nternal Loads Sub Total == Lights Floor Misc Glass/Door Cond Wall Cond gr/lb People Sub Total ==> Infiltration Partition/Door Adjacent Floor 57.8 64.7 Int Door ExFir Roof Wall Floor Gross Total Space Sens Btu/h HEATING COIL PEAK Space Peak 3,710 AREAS -132,335 43,103 -47,195 -83,976 -1,164 OADB: 13 4,091 Mo/Hr: Heating Design 000 0 0 0 000 0 0 Glass ft² Coil Peak Tot Sens -229,278 3 -83,976 -89,767 48,578 -43,103 -5,475 0 -8,517 1,560 Btunh 000 0 0 0 c Main Htg Aux Htg Preheat Of Total Percent 100.00 36.63 0.00 0.00 3.71 0.00 0.000 39.15 0.00 0.00 0.00 0.00 0.00 000 0.00 000 8 0 HEATING COIL SELECTION SADB Ra Plenum Return Ret/OA Return Exhaust Nom Vent AHU Vent ft*/ton % OA cfm/tt² Rm Exh Diffuser No. People cfm/ton Leakage Dwr ł Sec Fan Fn Frict Fn BidTD Fn MtrTD Btu/hr-ft* Leakage Ups Auxiliary MinStop/Rh Main Fan Terminal Capacity MBh -229.3ENGINEERING CKS TEMPERATURES 00 00 AIRFLOWS Coil Airflow cfm Cooling 17.9 Cooling 55.0 76.1 114.66 104.65 186 245.86 Cooling 7,955 2.14 7,955 2,386 1,420 1,420 7,955 7,955 7,955 76.1 1,420 888 0 0 0 59.0 0.0 8 -12 Heating 17.9 2.14 Heating 85.0 69.0 59.0 -61.80 Heating 1,420 1,420 7,955 7,955 1,420 0 0 0 0 0 7,955 7,955 88 0.0 0.0 ÷ 0 8

TRACE® 700 v6.3 calculated at 05:59 PM on 10/06/2014 Alternative - 1 System Checksums Report Page 2 of 10

Ext Doo

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3,326

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Opt Vent Humidif

Total

229.3

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Dataset Name: Project Name: TECH 2.trc

Total

32.4

388.3

Elementary School One

Addition- 3rd

Total	Opt Vent	Main Clg Aux Clg		Grand Total ==>	Supply Air Leakage	Underfir Sup Ht Pkup	Ret. Fan Heat	Sup. Fan Heat	Ov/Undr Sizing Exhaust Heat	Adj Air Trans Heat	Ventilation Load	Ceiling Load	Sub Total ==>	Misc	Lights	Internal Loads		Sub Total ==>	Adjacent Floor	Floor	Partition/Door	Glass/Door Cond Wall Cond	Glass Solar	Roof Cond	Skylite Cond	Envelope Loads				Pe	
33.8 406.0	4	24.7 296.6 0.0 0.0	Total Capacity ton MBh	213,346	ge	kup			Pine			1.172	93,743	1,752	17,966 74.025			118.431		_		d 7,853 3,523			49,201	10.05	Btu/h	Sens. + Lat.		Peaked at Time: Outside Air:	COOLING
U		220.5	6	3 21,094	0				-1.746			-1.172	3 4,492	0	4,492 0			1 19.521	.0			1029		12,039	6453		-	Sens. + Lat		0ADB/WB	COOLING COIL PEAK
	1,400	8,947 0	COOLING COIL SELECTION ens Cap. Coil Airflow Enter MBh cfm *F	296,578	0	0 0		0	-1.746	, o	62,137	0	98,234	1,752	22,458 74.025			137.952	0	0	•	7,853	57,805	12,039	49,201	10.054	Btu/h	Total		Mo/Hr: 7/18 OADB/WB/HR: 87/74/106	
		77.9 64.2 0.0 0.0	Enter DB/WB/HR	100.00	•			•			21	.	33	-	25 8			4	0	•	•	3 6	19.			t	(%)	Of Total			ç
	118.3	68.4	BUHR	198,449					0	•	•	1.212	64,032	4,941	17,966 41,125			133.205	• •	•	•	8,233 2,487	51,401	•	11,084	74 004		Sensible		Mo/Hr: 7 / 15 OADB: 91	CLG SPACE PEAK
		55.0 53.0 0.0 0.0	Leave DB/WB/HR	100.00 Gra	Sup	Un	Add	RA	O Exh	D Adj		1 Cel	32	1	21 g			67				**	26		0 0		(%)	Percent . Of Total		15	PEAK
ExFir Roof Wall Ext D		57.3 Floor 0.0 Part	gr/lb	Grand Total ==>	Supply Air Leakage	Underfir Sup Ht Pkup	Additional Reheat System Plenum Heat	RA Preheat Diff.	0 Exhaust Heat OA Preheat Diff.	Adj Air Trans Heat	Ventilation Load	Ceiling Load	Sub Total ==>	Misc	Lights People	Internal Loads		Sub Total ==>	Adjacent Floor	Floor	Partition/Door	Glass/Door Cond Wall Cond	Glass Solar	Roof Cond	Skylite Cond	Envelope Loads					
0 3,290 3,213 0	Int Door 0	or 3,290	AREAS Gross Total	-148,837	6	kup				-108 850		-1,032						-38,946				d -34,409					Btu/h	Space Peak Space Sens		Mo/Hr:	HEATING
558 17 1,002 31 0 0			Glass ft ² (%)	-245,628			32 364		1,538	-108 85	-88,502							-82,168				-34,409	0	-10,421	-31 4R			Coil Peak Tot Sens	i	Mo/Hr: Heating Design OADB: 13	HEATING COIL PEAK
Humidif Opt Vent Total	Preheat	Main Htg Aux Htg	표	8 100.00	0.00		-13.18			44 20		0.00	0.00	0.00	0.00			33.45	0.00			9 14.01		4.24		8		k Percent s Of Total			
-245.6	0.0	-245.6	HEATING COIL SELECTION Capacity Coil Airflow MBh cfm	No. People	ft²/ton Btu/hr-ft²	cfm/ton	ofm/ft ²	2	ENGINE		Leakage Ups	Auxiliary Leakage Dwn	Rm Exh	Exhaust	MinStop/Rh Return	Infil	AHU Vent	Nom Vent	Main Fan	Terminal	Diffuser		AIF		Fn Fnct	Fn BidTD	Fn MtrTD	Ret/OA	Ra Plenum	SADR	TEMP
		8,947	SELECT	165	97.25 123.39	264.47	272	Cooling	ENGINEERING CKS					1,400	2,684		1,400	1.400	146'9	8,947	8,947	Cooling	AIRFLOWS		5	8 8	0.0	76.1	76.1	Cooling 55.0	TEMPERATURES
0 0.0	0.0	0.0		"				Heating	N.		_													1						Heating 85.0	ŝ

Project Name: Elementary School One Dataset Name: TECH 2.trc

TRACE® 700 v6.3 calculated at 05:59 PM on 10/06/2014 Alternative - 1 System Checksums Report Page 3 of 10

By	Zone
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Total	-	Main Clg Aux Clg		Grand Jotal	Grand Total	Supply Air Leakage	Underfir Sup Ht Pkup	Net. Fan Heat	Sup. Fan Heat	Exhaust Heat	Ov/Undr Sizing	Adj Air Trans Heat	Ventilation Load	Ceiling Load	Sub Total ==>	Misc	People	Linkte	Internal Loads	Sub Total ==>	Infiltration	Floor Adiacent Floor	Partition/Door	Wall Cond	Glass/Door Court	Roof Cond	Skyllte Cond	Skylite Solar	Envelope Loads			Pea	
56.0 672.4	2	35.9 430.7 0.0 0.0	Total Capacity ton MBh		30M 54	e	kup					-		2,799	222,920	3,218	42,900	10 01		78,826					12,033	70 60			Btu/h	Sens. + Lat.	Space	Peaked at Time: Outside Air:	
4		7 272.4 0 0.0	(0	4,000		0				-3,859	0	0		9 -2,799	10,727	8	10,727			500			•	5			0	0	n Btun	Sen	Plenum	Mo OADB/WB/I	
	3,095	9,261 0	COOLING COIL SELECTION iens Cap. Coil Airflow Enter MBh cfm ^F	100,040	130 640	•	0 0			-3,859	••		121,535	0	233,647	3,218	53,635 176,794	50 DOD		79,326	0 0		0	1,100	7 500	0	0	0	Btu/h	Total	Net	Mo/Hr: 7/18 OADB/WB/HR: 87/74/106	
		79.8 67.3 0.0 0.0	ECTION Enter DB/WB/HR "F "F gr/l	0.00	8		•			<u>.</u>	••		28	•	54		4 7	3		18	•	<u>.</u>	•			1.0		•	(%)	Of Total	Percent :		4
	118.3	81.1 0.0	VB/HR	11 I I I I	225 074						•	0	•	2,799	144,345	3,218	42,900	40 008		78,826	•	0 0	0	600	2 502	10 000	0	•	Bturh		Space	Mo/Hr: 7 / 18 OADB: 87	
		53.0 52.2 0.0 0.0	Leave DB/MB/HR		10000	Su	5	SV	R	0	0 Ex	O Ad		1 Cel	64	1	گ ھ		Int	35	•				34		11		(%) : En	Of Total	Percent	1/18	
ExFir Roof Wall Ext Dooi		57.4 Floor 0.0 Part	gr/lb		and Total	Supply Air Leakage	Underflr Sup Ht Pkup	Additional Reheat System Plenum Heat	RA Preheat Diff.	OA Preheat Diff.	Exhaust Heat	Adj Air Trans Heat	Ventilation Load	Ceiling Load	Sub Total ==>	Misc	People	labto	Internal Loads	Sub Total ==>	Infiltration	Floor Adlacent Floor	Partition/Door	Wall Cond	Glass/Door Cond	Root Cond	Skylite Cond	Skylite Solar	Envelope Loads				
Door 1,07	oor	7,858	AREAS Gross Total		-154 074		Ð :	*			c 10,021-	406 070		-2,465	0	•	0 0			-25,533	0 0		0	-810	-24 723	, 0	0	0	Btu/h	Space Sens	Space Peak	Mo/Hr: OADB:	
0 0 702 66 0 0			Glass ft² (%)	interiore.	355			-11.956			3,399	400	-195,653							-26,214				-1,491	. *6				B	Tot Sens	Coil Peak	Mo/Hr: Heating Design OADB: 13	
Humidif Opt Vent Total	Preheat	Main Htg Aux Htg	I			0 0.00							553 54.88		0 0.00	0 0.00	0.00				0.00	0.00			101		0 0.00	0.00	Btu/h (%)		eak Percent	Ŧ	
0.0 0.0	0.0	-356.5	HEATING COIL SELECTION Capacity Coil Airflow MBh cfm	NO. Feople	Btu/hr-ft ²	ft ² /ton	cfm/ton	cfm/tt ²	% OA		ENGIN		Leakage Ups	Leakage Dwn	Rm Exh	Exhaust	Return		AHU Vent	Nom Vent	Sec Fan	Main Fan	Dimuser		,			Fn Frict	Fn MtrTD	Ret/OA	Return	SADB	
	0	9,261 50.3 0 0.0	Capacity Coil Airflow MBh cfm	5	303	140.22	165.27	1.18	Cooling 33.4		ENGINEERING CKS		0	0 0		3,095	9,261	2 778	3,095	3,095	0	9,261	9,201	Cooling	AINFLOWS			0.0	88	79.8	76.1		
88	8	0.0	- E -	11	45.37				Heating	1	s					3,095	9,261		3,095	3,095		9,261		Heating						50.3	69.0	Heating 85.0	

Elementary School One TECH 2.trc

Project Name: Dataset Name:

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Total	Opt Vent	Aux Clg	Main Clg			Grand Total ==>		Supply Air Leakage	Duct Heat Pkup	Ret. Fan Heat	Sup. Fan Heat	Exhaust Heat	Dehumid. Ov Sizing	Adj Air Trans Heat	Ventilation Load	Ceiling Load	Sub Total ==>	Misc	People	Liahts	Internal Loads	Sub Total ==>	Infiltration	Adjacent Floor	Floor	Partition/Door	Glass/Door Cond	Glass Solar	Roof Cond	Skylite Solar	Envelope Loads				Pes	,	
4.8 57.7	0.0 0.0	0.0 0.0	4.8 57.7	Total Capacity ton MBh		47,860		ge h								1.041	37,528	9,870	10,111	17.547		9,290	0	0		0 8,290				, o		Btu/h	Sens. + Lat.	00000	Outside Air:		
	0.0	0.0	53.2	Sens Cap. (MBh		4,986		0	0	0		0			0	-1.041	4,387	0	•	4.387		1,640		0		1,040	1 0	0	0.0	00		Btu/h	Sens. + Lat	Planim	MON OADB/WB/H		COOLING COIL PEAK
	0	•	2,172	Coil Airflow cfm		52,846		• •		0	0	00	,0	0	0	0	41,915	9,870	10,111	21,933		10,931	0	0	0 0	0	0	01	0.0				Total		MOTH: //15 OADB/WB/HR: 91/77/118		
	0.0 0.0	0.0 0.0	76.0 61.2	Enter DB/WB/HR		100.00				•	•	• •	0		•	•	79	19	19	42		21		•	• •	2	* 0	0.1	•			(%)	Of Tatal	Darrant		ç	2
	0.0	80	57.7	BIHR		97,516						04,101		•	0	1.041	33,034	9,870	5,617	17.547		9,290	0	0	0 0	9,290	0000	•	• •				Sansible		OADB: 91		CI G SPACE PEAK
	0.0 0.0	0.0	55.0 51.9	*F *F gr/lb		100.00 Gr		Su	Sy	A	RA	8		O Ad		1			6		I.	. 10					1			• •		(%)	Of Total				
ExFir Roof Wall Ext Door	0.0 Int Door	Ħ	53.0 Floor	gr/lb		Grand Total ==>		Supply Air Leakage	System Plenum Heat	Additional Reheat	RA Preheat Diff.	OA Preheat Diff.	Ov/Undr Sizing	Adj Air Trans Heat	Ventilation Load	Ceiling Load	Sub Total ==>	Misc	People	Liahts	Internal Loads	Sub Total ==>	Infiltration	Adjacent Floor	Floor	Partition/Door	Glass/Door Cond	Glass Solar	Roof Cond	Skylite Solar	Envelope Loads						
oor 1,925		•	3,213	Gross Total		-39,007		t	,				0	, ,		-1,217		•	0	0		-37,789	0	0	0 0		0		00			Btu/h	Space reak	Snara Dask	OADB:		HEATING
 				Glass ft ² (%)		-112,144				-67,308						•				•		-44,836		•		-44,030	000	0				Btu/h	Tot Sans	Coil Deal	Morhr: Heating Design OADB: 13	OILFEAN	
Humidif Opt Vent Total	Preheat	Aux Htg	Main Htg		F	100.00		000		8	0.00	000			0.00	0.00	0.00	0.00	8	0.00		39.98	8		2 9	0				0.00) ;	(%)	Of Total				
0.0 0.0 -112.1	0.0	0.0	-112.1	Capacity Coil Airflow MBh cfm	HEATING COIL SELECTION	No. People	Btu/hr-ft*	ft²/ton	cfm/ft ²	% OA		ENGIN			Leakage Ups	Leakage Dwn	Rm Exh Auxiliany	Exhaust	Return	MinStop/Rh	AND VEN	Nom Vent	Sec Fan	Main Fan	Terminal	Diffuser		AIF		Fn Frict	Fn BldTD	Fn MtrTD	RetiOA	Ra Plenum	SADB		TEMP
00	0 0	0.0	4,396 55.0	coil Airflow I		22	17.94	668.76	1.37		Cooling	ENGINEERING CKS			0	0			4,396	•		0	•	4,396	4,396	4,396	Cooling	AIRFLOWS		0.0	0.0	0.0	76.0	76.0			EDATINES
0.0 0.0	0.0 0.0	0.0 0.0	.0 78.0	Fint Lvg			-34.90		1.37	0.0	Heating				_				4,396				_	4,396	4,396	4,396	Heating			0.0	0.0	0.0	68.8	68.8	Heating 78.0		

Project Name: Dataset Name:

Elementary School One TECH 2.trc

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Total	Opt Vent	Main Clg Aux Cla		Grand Total ==>	Supply Air Leakage	Duct Heat Pkup	Ret. Fan Heat	Exhaust Heat	Ov/Undr Sizing	Adj Air Trans Heat	Ventilation Load	Ceiling Load	Sub Total ==>	Misc	People	Lights	Internal Loads	Sub Total ==>	Infiltration	Adjacent Floor	Partition/Door	Wall Cond	Glass/Door Cond	Roof Cond	Skylite Cond	Envelope Loads				
47.6	18.8	28.8	Total C ton		nt PKup Ikage				Burrie	leat	ä							ľ					2			1s		Can	Outside Air:	COC
571.1	225.4	345.7	Total Capacity Ion MBh	293 293					94,123	0	, 0	0	162,007	5,966	136,950	19 091		37,163	•	0 0	00	21,320		15,843		•	Btu/h	Space	Air	
	160.8	244.4	COOLING Sens Cap. (MBh	12 184	0	0	7,412	0			•	0	4,773	0	0	4 773		0		0		•		0	0 0	,	Btu/h	Plenum	OADB/WB/H	
	5,000	15,634 0	COOLING COIL SELECTION sens Cap. Coil Airflow Enter MBh cfm *F	 312.889	00		7,412		94,123	• •	, .	0	166,780	5,966	136,950	23,864		37,163	•			21,320		15,843	0 0	,	Iotal Btu/h	Net	OADB/WB/HR: 87 / 74 / 106	Moltr 7/18
	-	75.3 65.2 0.0 0.0	ECTION Enter DB/WB/HR F °F gr/l	100.00	0.0		NN		80				5	2	4			12	•	<u>.</u>			, e	G			Of Iotal	Percent	6	
	79.1	77.4	NB/HR gr/b	225 402					94,123	•		0	93,532	5,966	68,475	19 091		37,747	•			20,084		17,663		,	Sensible Btu/h	Space	OADB: 89	CLG SPACE PEAK
		61.6 58.2 0.0 0.0	Leave DB/WB/HR	100.00	Sr of	Sy	Ad		42 Ex				41			0 0	Int	17							1		(%)	Percent		PEAK
Exfi Roof Wall Ext (_	67.7 Floor	grib	: 100.00 Grand Total ==>	Supply Air Leakage	System Plenum Heat	Additional Reheat	OA Preheat Diff.	Exhaust Heat	Adj Air Trans Heat	Ventilation Load	Ceiling Load	Sub Total ==>	Misc	People	Lights	Internal Loads	Sub Total ==>	Infiltration	Adiacent Floor	Partition/Door	Wall Cond	Glass Solar	Roof Cond	Skylite Cond	Envelope Loads				
Door	Int Door		Gross Total		ge	feat	-																3			l	de	sp		H
0 3,496 2,387 0	0	3,496	AS	-69.355							• •	0	•	•	0 0	•		-69,355	•	• •	00	-55,784		-13,570		•	Space Sens Btu/h	Space Peak	OADB: 13	Molth: Heating Deelo
0 0 0 0 0 0			Glass ft² (%)	-100 963			0	-26,935										-69,355				-55,784		-13,570			lot Sens Btu/h	Coil Peak	OADB: 13	VIL PEAK
Humidif Opt Vent Total	Preheat	Main Htg Aux Htg	Ŧ	3 100 00	0.00	0.00	0.00				0.00	0.00	0.00	0.00	0.00	000		5 68.69	0.00		0.00		0,00			۱.	h Of Iotal			
0.0 0.0	0.0	-118.3	HEATING COIL SELECTION Capacity Coil Airflow I MBh cfm	Btu/hr-ft ² No. People	ft?/ton	cfm/ft ²	% OA		ENGIN		Leakage Ups	Leakage Dwn	Rm Exh Auxiliary	Exhaust	Return	MinSton/Rh	AHU Vent	Nom Vent	Sec Fan	Main Fan	Terminel		All		rn met	Fn BIdTD	Fn MtrTD	Return	SADB Ra Plenum	TEMP
	0	15,634 6 0	Capacity Coil Airflow	163.37 249	73.45	4.47	3.2	Cooling	ENGINEERING CKS		0	0		500	15,634		500	500	•	15,634	15 634	Cooling	AIRFLOWS		6.0	2.0	0.0	75.3	62.0 75.0	TEMPERATURES
0.0	0.0	68.2 0.0	- E Z	-33.84		4.47	0.0	Heatin	ŝ						15,634					15,634	15 634	Heating				0.0	0	70.0	75.0 70.0	

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Project Name: Dataset Name:

Elementary School One TECH 2.trc

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Burtler: Burtler: Formation Model: 91/4 Model: Mode:: Mo	Bible: Bible: Mode: 914 <	45.0 539.6	214.1 10	27.1 325.5 195.1 0.0 0.0 0.0	Total Capacity Sens Cap. ton MBh MBh		207,127 4,119	Supply Air Leakage 0	Underfir Sup Ht Pkup	0		-4,586	0	•	Adi Air Trans Heat 0	2,546 -2,546	151,696 /,268			29,073 7,268		52,884 3,982	0		• •	3,96	6 224				_	Space Plenum Sens. + Lat. Sens. + Lat		Peaked at Time: I Outside Air: OADBM	
Mohrt: P / 14 OADB: 83 Mohrt: Heating Design OADB: 13 Mohrt: Heating Design OADB: 13 Space Percent Space Sens Space Percent Space Percent Space Percent Space Percent Space Percent Space Sens Space Percent Space Perce	Mohrt: I (*internal Buh Mohrt: Heating Design (*internal Space Space Ferrent Space Space Ferrent Buh Space Space Ferrent Buh Space Space Space Space Space Space Space		2,740	8,471 0	Coil Airflow cfm		325,526	0	0	0	00												0	0	0				00	,	Btu/h	Total		Mo/Hr: 7 / 18 /B/HR: 87 / 74 / 106	
111 Mohr: Heating Design OADB: Space Feak Space Sens Coil Peak Space Sens For ent Space Sens Space Feak Space Sens Space Sens Coil Peak Space Sens For ent Space Sens Space Sens	11 Mohr: Heating Design CADE Space Peak Bunh Cooling Coll Peak Bunh Source Bunh Cool Peak Bunh Force Floor Cool Peak Floor Force Floor Cool Peak Floor Force Floor Force Floo< Floor Force Floor <th< th=""><th></th><th>76.9 11</th><th>66.9 7 0.0</th><th>PBMB</th><th></th><th></th><th></th><th></th><th></th><th></th><th>÷.</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>^v</th><th></th><th>OADE</th><th></th></th<>		76.9 11	66.9 7 0.0	PBMB							÷.																				^v		OADE	
Mohrt: Heating Design OADE: 13 Space Peak Bluh Coil Peak Bluh Percent Bluh Ra Pie Ra Pie Bluh Space Sens Tot Sens Of Total Bluh Ra Pie Ra Pie Bluh Ra Pie Ra Pie Ra Pie Bluh Ra Pie Ra	Mort+: Heating Design CADB: Coil Peak Blum Fercent Tot Sens Ra Plenum 763 Ra Plenum Sons Coil Peak Blum Coil Peak Blum Fercent Ra Plenum Ra Plenum 763 Ra Plenum Sons Coil Peak Blum Fercent Ra Plenum Ra Plenum 763 Ra Plenum Sons Coil Peak Ra Plenum Sons Coil Peak Ra Plenum Sons All FLOWS Ra Plenum 763 Ra Plenum Sons All FLOWS Sons All FLOWS Sons So			54.5	Leave DB/WB/HR			Supply Air	Underfir S	System Pl	Additional	OA Prehes	•			-	4		35	5	Internal Lo	45			••••			. 0	1	1.1				n 9/14 883	
Hr: Heating Design DB: SADB eak Coil Peak Tot Sens Of Total Bluh Ra Pie Retro 0 No No Pie Retro 0 Ra Pie Retro 0 Ra Pie Retro 0 Ra Pie Retro 0 Ra Pie Retro 0 No No Pie Retro 0 Ra Pie Retro 0 Ra Pie Retro 0 Ra Pie Retro 0 No No Pie Retro 0 No No Pie Retro 0 N	Hr.: Heating Design DB: Cooling SADB Cooling SaDB <th>Door</th> <th></th> <th>Floor Part</th> <th>Gross</th> <th></th> <th>v</th> <th>r Leakage</th> <th>up Ht Pkup</th> <th>enum Heat</th> <th>Reheat</th> <th>AL DIM.</th> <th>G</th> <th></th> <th>ns Heat</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>Nads</th> <th></th> <th>ž</th> <th>t Floor</th> <th>vDoor</th> <th></th> <th></th> <th>nd</th> <th>Sond</th> <th>Loads</th> <th>-</th> <th>Space</th> <th></th> <th>0-</th> <th></th>	Door		Floor Part	Gross		v	r Leakage	up Ht Pkup	enum Heat	Reheat	AL DIM.	G		ns Heat						Nads		ž	t Floor	vDoor			nd	Sond	Loads	-	Space		0-	
Kk Percent Rape Band Of Total Return Control 0.00 Fin Bid Control 0.00 Terminitian Control 0.00 Return Contreturn Sont <td>Kk Percent Percent B SADB Ra Plenum Cooling 76.5 is OT Tetal Fin Return Fin 76.5 is OT Tetal Fin Fin 76.5 is OT Tetal Fin Fin 76.5 is O 0.00 0.00 0.00 is 0.000 Fin Fin 0.0 is 18.75 Diffuser 8.471 0.0 is 0.000 See Fan 0.0 0.000 infiti S.309 MinStopRith 2.740 8.471 infiti -1.51 Englither 8.471 0 infiti -1.51 Englither 2.740 0 infiti -1.51 Englither 2.740 0 infiti -1.51 Englither 2.541 0 0 infiti -1.51 Englither 2.541 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td></td> <td>00</td> <td>0</td> <td>Glass ft²</td> <td></td> <td>c</td> <td>• •</td> <td>•</td> <td>•</td> <td></td> <td></td> <td>0</td> <td>• •</td> <td>• •</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Mo/Hr: Heating D DADB: 13</td> <td></td>	Kk Percent Percent B SADB Ra Plenum Cooling 76.5 is OT Tetal Fin Return Fin 76.5 is OT Tetal Fin Fin 76.5 is OT Tetal Fin Fin 76.5 is O 0.00 0.00 0.00 is 0.000 Fin Fin 0.0 is 18.75 Diffuser 8.471 0.0 is 0.000 See Fan 0.0 0.000 infiti S.309 MinStopRith 2.740 8.471 infiti -1.51 Englither 8.471 0 infiti -1.51 Englither 2.740 0 infiti -1.51 Englither 2.740 0 infiti -1.51 Englither 2.541 0 0 infiti -1.51 Englither 2.541 0 0 0 0 0 0 0 0 0 0 0 0 0		00	0	Glass ft²												c	• •	•	•			0	• •	• •									Mo/Hr: Heating D DADB: 13	
ADB SADB Ra Pie Ra Pie Return Fn Bid Fn Bid Fn Bid Fn Bid Nom V Inffus See Fa Return Exhur Return Exhur Com/te No. Pp No. Pp	SADB SADB SADB Ra Plenum Fin BidTD Fin BidTD Diffuser Fin BidTD Diffuser Fin BidTD Sac Fan Nom Vent AHU Vent Return Sac Fan Nom Vent Return Re		Pre	Mai Aux	3	╢		0	•	-5,558	• •	0	4,911	62,495	0	0	-	• •	•	0		88,061	0	0 0	0	60,839	0 0		• •	•		_		esign	
ADB TING COIL SI Capacity Co -324.4 0.0 0.0 0.0 0.0 0.0 0.0 0.0	KADB Cooling 54.7 beturn n MtrTD 54.7 0.0 a Plenum 76.5 beturn n MtrTD 0.0 in BidTD 0.0 0.0 in Frict 0.0 8.471 tain Fan 8.471 8.471 isin Fan 8.471 2.740 HII Vent 2.740 0 HII Vent 2.740 0 is OA 3.2.3 0 sakage Ups 0 0 sakage Ups 0 0 sold and the property tool Airflow 118.40 118.40 tubber 101.35 2.56 101.35 to. People 126 2.66 0.0 0.0 0 0 0.0 0.0 0 0	nidif Vent	heat	n Htg	Ş		_	_	_		_	80	-1.51	1 2 2 1	_	_	-		_	-	. >	_		-		_	8.00	88			_	_		60	_
	Cooling 5.5.7 5.5.7 5.5.7 5.5.5 76.5 76.5 76.5 7	4	0.0	-324.4 0.0	Capacity C MBh		Vo. People	t-/ton	fm/ton	fm/ft²	6 OA		ENGINE		eakage ups	eakage Dwn	uxiliary	xhaust	eturn	linStop/Rh	HU Vent	om Vent	ec Fan	lain Fan			AIN		n Fnct	n BidTD	n MtrTD	teturn MiOA	a Plenum	ADB	

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Project Name: Dataset Name:

Elementary School One TECH 2.trc

By	Zone
ACADEMIC	Checksums

Existing- 2nd

Opt Vent Total	Main Clg Aux Clg		Grand Total ==>	oupply Air Leakage	Underfir Sup Ht Pkup Supply Air Leakane	Duct Heat Pkup	Ret. Fan Heat	Exhaust Heat Sup. Fan Heat	Ov/Undr Sizing	Dehumid. Ov Sizing	Adj Air Trans Heat	Ventilation Load	Cailing Load	Sub Total ==>	Misc	Lights	Internal Loads		Sub Total ==>	Infiltration	Adiacent Floor	Partition/Door	Wall Cond	Glass Solar	Roof Cond	Skylite Cond	Envelope Loads				Pea	
41.9 503.1 93.0 1,115.6	51.0 612.5 0.0 0.0	Total Capacity ton MBh	341,387	Je	kup				0	20		0	2 047	235,240	4,396	45,084			102,199	0			21,447		0.0			Btu/h	Sens. + Lat.	0	Peaked at Time: Outside Air:	COOLING
257.1	348.4 0.0	COOLING Sens Cap. MBh	2,460	-	0	0	0	-10,778	10 110			0	2 047	11,271	0	11,271			5,914		0		5,914		0.0		,	Btu/h	Sens. + Lat		Mo/ OADB/WB/H	COOLING COIL PEAK
6,440	13,453 0	COOLING COIL SELECTION iens Cap. Coil Airflow Enter MBh cfm *F	612,445	•			0.0	-10,778	10	0	0	268.599	•	246,511	4,396	56,355 185,760			108,113	0			27,360	67,508	0.0		>	Btu/h	Total		Mo/Hr: 7 / 18 OADB/WB/HR: 87 / 74 / 106	
91.0 76.9	81.6 68.6 0.0 0.0	Enter DB/WB/HR	100.00					•	0	•	•	4.	2	40	-	89			18	0	•.•	•	4	, 1) 		(%)	Of Total		6 	Q
118.3	84.6 0.0	VBIHR	298,494						0	(•		0 404	160,683	12,398	45,084			135,688	0		0	3,143 4,640	125,903	•				Sensible	0	Mo/Hr: 9 / 14 OADB: 83	CLG SPACE PEAK
55.0 54.9	55.0 54.3 0.0 0.0	•F •F gr/lb	100.00 Grand Total ==:	- up	2 Und	Sys	Add	RA	0 Exh	1.11	-	0 Ven	2		1	3 5 P C			45 : S		0.0 > T							(%)	Of Total		3 14	PEAK
64.7 Int Door ExFir Roof Wall Ext Door	62.1 Floor 0.0 Part	97/lb	nd Total ==>	oupply Air Leakage	Underfir Sup Ht Pkup Supply Air Leakane	System Plenum Heat	Additional Reheat	DA Preheat Diff.	0 Exhaust Heat	Ov/Undr Sizing	Adj Air Trans Heat	Ventilation Load		Sub Total ==>	Misc	Lights People	Internal Loads	anal loado	Sub Total ==>	Infiltration	Hoor Adiacent Floor	Partition/Door	Wall Cond	Glass Solar	Roof Cond	Skylite Cond	Envelope Loads					
5,431	8,256	AREAS Gross Total	-223,798		5	-				-94,549			-4.228						-125,021				-57,016					Btu/h	Space Sens	Casas Deal	Mo/Hr: Hes OADB: 13	HEATING
0 0 1,701 31		Glass ft ² (%)	-643,478			,b				-94,549		-407,110	-	-	-				-144,595				-36,590						Tot Sens	2	Mo/Hr: Heating Design OADB: 13	HEATING COIL PEAK
Prehest Humidif Opt Vent Total	Main Htg Aux Htg			•	• •	-8,767 1	00	•••					0	•		••				0	• •	0			00				ens Of Total		gn	î
nt 0.0	itg -643.5 1g 0.0	HEATING COIL SELECTION Capacity Coil Airflow MBh cfm	00.00 No. People	Btu/hr-ft ²				000			0		0.00 Auxiliary	_	_	0.00 MinStop/Rh		AHU Vent	_		0.00 Main Fan		_	0.00 A				_	otal Ret/OA	_	SADB	TEM
	13,453 4 0	VG COIL SELECTION Capacity Coil Airflow MBh cfm	413	135.12	144.71	1.63			ENGINEERING CKS					0	6,440	4,036		6,440	6,440	0	13,453	13,453	Cooling	AIRFLOWS		0.0	0.0	0.0	81.6	76.5	Cooling 55.0	TEMPERATURES
0.0	41.9 0.0	- E		-77.94		1.63	47.9	Heati	S						6,440	13,453		6,440	6,440		13,453	13,453	Heating				0.0	_	41.9	68.4	Heating 85.0	00

TRACE® 700 v6.3 calculated at 05:59 PM on 10/06/2014 Alternative - 1 System Checksums Report Page 8 of 10

Project Name: Dataset Name:

Elementary School One TECH 2.trc

Ву	Zone
ACADEMIC	Checksums

Existing- 3rd

COUNT OF CLAR CONTROPOLITE CLARENCE CLARENCE <th></th>																																									
COCUNC COLUPEAX CLIS SPACE PEAX HUNC FINIC PEAX <th< th=""><th></th><th>Opt Vent</th><th>Aux Cig</th><th></th><th></th><th></th><th></th><th>Grand Total ==></th><th></th><th>Supply Air Leaka</th><th>Underflr Sup Ht P</th><th>Duct Heat Pkup</th><th>Dat Fan Haat</th><th>Exhaust Heat</th><th>Ov/Undr Sizing</th><th>Dehumid. Ov Sizi</th><th>Adj Air Trans Hea</th><th>Ventilation Load</th><th>Ceiling Load</th><th></th><th>Sub Total ==></th><th>Misc</th><th>People</th><th>Internal Loads</th><th>atoma lando</th><th>Sub Total ==></th><th>Infiltration</th><th>Adjacent Floor</th><th>Floor</th><th>Dartition/Door</th><th>Glass/Door Cond</th><th>Glass Solar</th><th>Roof Cond</th><th>Skylite Cond</th><th>Shulite Solar</th><th></th><th></th><th></th><th></th><th>Pea</th><th></th></th<>		Opt Vent	Aux Cig					Grand Total ==>		Supply Air Leaka	Underflr Sup Ht P	Duct Heat Pkup	Dat Fan Haat	Exhaust Heat	Ov/Undr Sizing	Dehumid. Ov Sizi	Adj Air Trans Hea	Ventilation Load	Ceiling Load		Sub Total ==>	Misc	People	Internal Loads	atoma lando	Sub Total ==>	Infiltration	Adjacent Floor	Floor	Dartition/Door	Glass/Door Cond	Glass Solar	Roof Cond	Skylite Cond	Shulite Solar					Pea	
CLG SPACE PEAK HEATING COLL PEAK TEMPERATURES TEMPERATURES TEMPERATURES TEMPERATURES TEMPERATURES TEMPERATURES TEMPERATURES TEMPERATURES Conting training trainin						Total Capacity		368,729		ge .	kup				0	Bu			4,131	240,710	245 740	4.128	47,181			118,888	0	0		20,400		75,578	0.0			Btu/h	Sens. + Lat.	Space	Outside Air:	ked at Time:	COOLING
CLG SPACE PEAK HEATING COLL PEAK TEMPERATURES Moht: P 415 OUCB: 413 OUCB:		223.6	0.0	387.6	MBh	Sens Cap.	COOLING	29,516		0		0 0	0	-9,372				•	-4,131	CB1,11	11 705	0 0	11,795			31,224		•		2004	0	0	23,762	0 0		Btu/h	Sens. + Lat	Plenum	OADB/WB/H	Mol	COIL PEAK
CLG SPACE PEAX HEATING COLL PEAX TEMPERATURES Mohl:: 41:5 OUCD: 41:5 OUC		5,600	0	14,423	cfm	Coil Airflow	COIL SELE	631,927		•	0	0 0		-8,372	0	•	0	233,683	0	000,102	267 505	4.128	194 400			150,112	0	0	0 0	0,070	13,903	75,578	23,762		>	Bturn			HR: 8777471	Hr. 7/18	
ACCE PEAK HEATING COLL PEAK TEMPERATURES Nobit: 91 / 5 Nobit: 9					ц.	Enter DBM	CTION	100.00		•	•			4		•	•	37	•		<u>.</u>		<u>ي</u> د			24		•	0.0	•	C/ 0	12		2.9		(%)	Of Total	Percent :			Q
HEATING COLL PEAK Mohr: Hailing Dealin Coulds TEMPERATURES Mohr: Hailing Dealin Coulds Space Sensition Blanh Coil Peak Blanh Ferret Blanh Space Sensition Blanh Space Sensition Blanh Coil Peak Blanh Space Sensition Blanh Space Sensition Blanh Space Sensition Blanh Coil Peak Blanh Ferret Blanh Space Sensition Blanh Space Sensition B		118.3	0.0	81.0	gub	VB/HR		319,919							•		0	•	2,497	104,001	108 451	13.270	47,181			148,972	0	0		0,400	6,259	133,414	•			Bturn			OADB: 8	Mo/Hr: 9	LG SPACE
TEMPERATURES Mohrt: Heating Design OADB: Tot Same Blum Ferrent Blum Same Space Peak Blum Cooling Ferrent Blum Ferrent Blum Same Space Semi Blum Cooling Blum Heating Blum Cooling Ferrent Blum Ferrent Blum Same Space Semi Blum Ferrent Blum Same Space Semi Blum Ferrent Blum Same Space Semi Blum Ferrent Blum Same Space Semi Blum Ferrent Blum Same Statum		55.0 54.9			J. J.	Leave DB/		100.00 Gra		Sup	Und	Svs				OVI	- 61		1 Cell						Inte					• •					0.50		Of Total	Percent :			PEAK
TEMPERATURES Space Peak Space Sensi Blum Cooling Save Space Sensi Blum Cooling Save Space Sensi Blum Cooling Save Save Save Save Save Save Save Save	Rool Wall	_	-		gr/lb	WB/HR		nd Total ==>		ply Air Leakage	lerflr Sup Ht Pk	tem Plenum Hea	Preneat Unt.	Preheat Diff.	aust Heat	Undr Sizing	Air Trans Heat	tilation Load	ing Load		wh Total ==>	lisc	ignts		rnal Loads	ub Total ==>	nfiltration	djacent Floor	bor	artition/Door	slass/Door Cond	lass Solar	oof Cond	kylite Cond	elope Loads						
TEMPERATURES Total peak rot sens bunk Percent rot sens problem Cooling satus fin Heating Satus fin Cooling satus fin Heating satus fin Cooling satus fin Heating fin -20.487 3.36 0.00 0.00 Rate menum field 76.5 68 -41.219 0.00 0.00 fin MitTD 0.0 0 -51.219 10.00 16.70 0.00 Fin Frict 0.0 0 -41.4.010 16.70 0.000 Fin Frict 0.0 0 0 0 0.000 0.000 Infil 0.000 Set figs 14.423 14.423 14.423 10.038 -1.65 0.000 Mitting Exhaust 5.600 <td< td=""><th>or</th><td>ğ</td><td>0</td><td></td><td></td><td>Gross Total</td><td>AREA</td><td>-239,94</td><td></td><td></td><td>5</td><td>•</td><td></td><td></td><td></td><td>-84,40</td><td></td><td></td><td>-4,42</td><td></td><td></td><td></td><td></td><td></td><td></td><td>-151,11</td><td></td><td></td><td></td><td>enten.</td><td>-61,21</td><td></td><td></td><td></td><td></td><td>Btu</td><td>Space Sen</td><td>Space Pea</td><td>OADE</td><td>Mo/H</td><td>HEATING</td></td<>	or	ğ	0			Gross Total	AREA	-239,94			5	•				-84,40			-4,42							-151,11				enten.	-61,21					Btu	Space Sen	Space Pea	OADE	Mo/H	HEATING
n Cooling sak rest rest rest rest rest rest rest rest					ft= (%	Glass						14			10							00		•				0	00								-			r: Heating Des	COIL PEA
TEMPERATURES Cooling Cooling Rapleaum Heatin 76.5 Raturn Return Fin BidTD 0.0 0.0 Fin BidTD 0.0 0 Fin BidTD 0.0 0 Fin BidTD 0.0 0 Marto 88.7 46 Peturin 76.5 68 Retion 76.5 68 Retion 80.7 46 Diffuser 14.423 14.423 Minstop/Rh 14.423 14.423 Nom Vent 5.600 5.600 Scar Fan 14.423 14.423 Nom Vent 5.600 5.600 Scar Fan 14.423 14.423 Minstop/Rh 4.327 14.423 Leaskage Dwn 0 5.600 Leaskage Dwn 0 5.600 Leaskage Dwn 16.8 18.8 Mith 1.8.7 1.6 Muhrite 12.7.8 .70.5 Buuhrite 12.3.78 .70.5 No. Peopl		Pre	Au	Ma	_		╡	163		0	•	.325		• •	038	401	0	9009	•	•		0 0		•		,716	•	•	0 0		219	•	487	• •		stum				ĝ	~
6885 600	midif t Vent 'al	heat	BIH X	in Htg			щ	0.00		0.00	0.00	-2.35			-1.65	13.84	•	58.06	0.00	0.00		000				32.10	0.00	0.00	000		10.04	00	3.36		8	(%)	f Total	ercent			
6885 600 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-609.8	0.0	0.0	-609.8	MBh	Capacity C	ATING COIL S	No. People	Btu/hr-ft*	ft*/ton	cfm/ton	cfm/ft ²	% OA		ENGINE			Leakage Ups	Leakage Dwn	Auxiliary	Rm Exh	Exhaust	Return		AHU Vent	Nom Vent	Sec Fan	Main Fan	Terminal	Diffuser		AIF			En Erict	En BIATO	RetIOA	Return	SADB Ra Plenum		TEMP
Image: Second	• •	0	0			oil Airflow	SELECTION	432	123.78	96.95	161.84				EERING CK			•	0	0 0	•	5,600	4,327		5,600	5,600	0	14,423	14,423	14,423	Cooling	RFLOWS				88	80.7	76.5	55.0 76.5		ERATURES
				~		1			-70.57			1.67	38.8	Heating	S			•	•	•	•	5,600	14,423		5,600	5,600	•	14,423	14,423	14,423	Heating						46.9	68.4	68.4	Heating	

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Project Name: Dataset Name:

Elementary School One TECH 2.trc

Checksums Academic	BV	Zone
	ACADEMIC	(sun

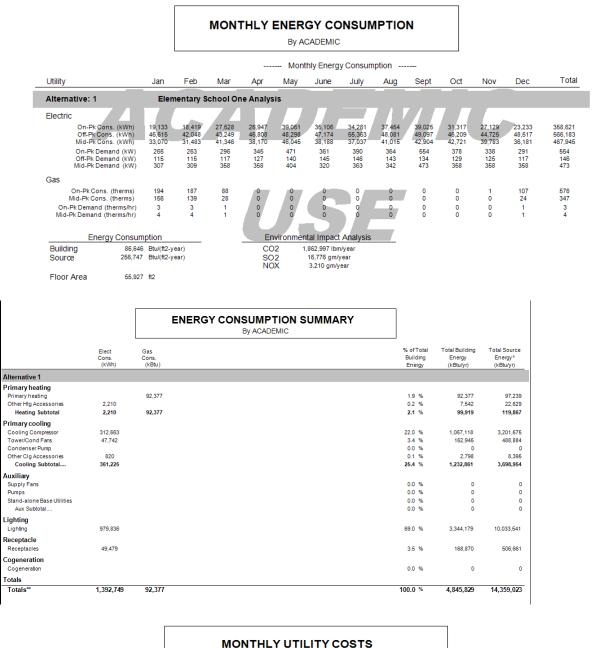
Multi-purpose

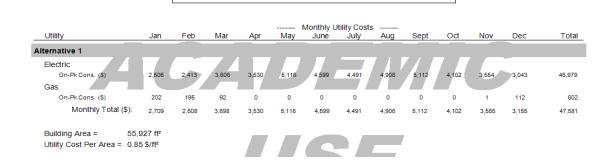
0.0				~										
0.0	Humidif Opt Vent		(1)		Roof							752.5	62.7	Total
	Preheat	Pre		• •	60.8 Int Door ExFir	55.0 54.0	55	68.3 79.1	84.0 68	5,000	160.8	225.4	18.8	Opt Vent
	BIH X	2		, .	_		0.0							Aux Cig
-145.3	Main Htg	Ma		4,020	49.0 Floor	50.7	54.6			16,380	384.3	527.1	43.9	Main Clg
Capacity Coil Airflow	HEATING COIL SELECTION Capacity Coil Airflow MBh cfm		Glass ft ² (%)	Gross Total		Leave DB/WB/HR	-15	F *F gr/b	ECTION Enter D	Sens Cap. Coil Airflow Enter MBh cfm "F	COOLING Sens Cap. MBh	Total Capacity ton MBh	Tota	
		╢			л 	1	1	I						
No. People	100.00 No. Peop	230	-121,230	-121,230	d Total ==>	100.00 Grand Total ==		363,316	100.00	458,310	13,253	437,291	8	Grand Total ==>
	0.00	•			Supply Air Leakage	ddne							akage	Supply Air Leakage
ŝ	_	• •			Underfir Sup Ht Pkup	Unde					•		Ht Pkup	Underflr Sup Ht Pkup
7		•			System Plenum Heat	Syste				•	0		þ	Duct Heat Pkup
1	0.00 % OA	•			Additional Reheat	Additi			N	7,765	7,765			Ret. Fan Heat
	000	0 0			RA Preheat Diff.	RAP			N C	7.765				Sup. Fan Heat
ENGINEERING CKS	0.00	• •			Exhaust Heat	0 Exhau	•				•	0	ũ	Ov/Undr Sizing
	20.49		-24,845	-24,845	Ov/Undr Sizing	OVU			•	0			Sizing	Dehumid. Ov Sizing
		0		0	Adj Air Trans Heat		•		•	•		•	Heat	Adj Air Trans Heat
Leakage Ups		• •			Ventilation Load	0 Ventil	•••		• •			• •	ad	Ventilation Load
liary	Auxiliary	•									•	•		Calling
×h	0.00 Rm Exh	•			Sub Total ==>			97,574	39	177,037	5,488	171,549	Ŷ	Sub Total ==>
ust	_	•		•	6	0 Misc		1,646	•	1,646	0	1,646		Misc
3		•		0	People			73,975	32	147,950	0	147,950		People
MinStop/Rh	0.00 Mins	0		0	hts	6 Lights	52	21,952	6	27.441	5,488	21,952		Lights
Infil And vent					Internal Loads	Intern							6	Internal Loads
Nom Vent	Nom	000,08	-90-	-90,300	SUD TOTAL	73 ou	43	265,743	8	265,743	0	205,743	Ŷ	Sub lotal ==>
an	_		00	00 000	Cub Total						,			Inilluation
	_	• •		, .	Adjacent Floor		• •				0	, .	9	Adjacent Floor
linal	_	•		0	q		•				,	0		Floor
Ser		•		0	Partition/Door	0 Par	•		•	•		•	*	Partition/Door
	_		-b	-6,264	Wall Cond	- 1	5	5,565	ļ	5,565	•	5,565		Wall Cond
	61.47	I.		-74,517	Glass/Door Cond			16,859		16,859	•	16,859	Cond	Glass/Door Cond
AIRFLOWS	000				Glass Solar			225,757	49	225,757	•	225,757		Glass Solar
	12 87		-15 604	-15 604	Roof Cond	1	<u>n</u> .	17.561		17.561		17.561		Roof Cond
rict	0.00 Fn Frict	• •			Skylite Solar	sky								Skylite Solar
Fn BidTD	_				Envelope Loads			i				,	spi	Envelope Loads
Fn MtrTD	_		B	Bturh		(%)	_	₽	(%)	Btu/h	Btu/h	Btu/h		
Å			Tot Sens	Space Sens		<u>.</u>		Sensible	Of Total	Total	Sens. + Lat	Sens. + Lat.	s	
Return	Percent Return		Coil Peak	Space Peak		at .	ice Percent	Space	Percent	Net	Plenum	Space		
en m	SADB		13	OADB:			OADR: 87			DADB/WB/HK: 8/ / /4 / 105	OADBWBM	Outside Air:	Outs	
'		gn	Mo/Hr: Heating Design	Mo/Hr:			Mo/Hr: 7 / 18	M		Mo/Hr: 7/18	Mo	t Time:	Peaked at Time:	
TEMPERATURES		1	HEATING COIL PEAK	HEATING		×	ICE PEA	CLG SPACE PEAK			COOLING COIL PEAK	DOLING C	2	

Project Name: Dataset Name: Elementary School One TECH 2.trc

TRACE® 700 v6.3 calculated at 05:59 PM on 10/06/2014 Alternative - 1 System Checksums Report Page 10 of 10

Appendix C- Energy Consumption Output





By ACADEMIC